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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

KIELIN, ERIK J

ART UNIT PAPER NUMBER

2813

DATE MAILED: 10/15/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/975,466

Applicant(s)

SOPHIE ET AL.

Examiner

Erik Kielin

Art Unit

2813

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 28 August 2002.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-32 is/are pending in the application.
- 4a) Of the above claim(s) 18-27 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-17 and 28-32 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 09 October 2001 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s) _____.
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 4,6. 6) ☐ Other:

DETAILED ACTION

Election/Restrictions

1. Applicant's election of claims 1-17 and 28-32 in Paper No. 7 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).
2. Claims 18-27 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim.

Priority

3. Applicant is advised of possible benefits under 35 U.S.C. 119(a)-(d), wherein an application for patent filed in the United States may be entitled to the benefit of the filing date of a prior application filed in a foreign country.

More specifically it is noted that there exists no claim for priority in the declaration over either of the applications Finland 20001163 and PCT/FI01/00473. Nor have copies of the certified copies of the PCT and foreign application been received, as required for priority.

Information Disclosure Statement

4. The information disclosure statement filed 29 January 2002 fails to comply with the provisions of 37 CFR 1.97, 1.98 and MPEP § 609 because some of the references have not been provided with dates in accordance with 37 CFR 1.98(b)(5). Also the MPEP 609 states,

“Each publication must be identified by publisher, author (if any), title, relevant pages of the publication, and **date** and place of publication. The date of publication supplied must include at least the **month and year** of

Art Unit: 2813

publication, except that the year of publication (without the month) will be accepted if the applicant points out in the information disclosure statement that the year of publication is sufficiently earlier than the effective U.S. filing date and any foreign priority date so that the particular month of publication is not in issue.” (Emphasis added.)

The IDS has been placed in the application file, but only the references initialed by Examiner have been considered. Applicant is advised that the date of any re-submission of any item of information contained in this information disclosure statement or the submission of any missing element(s) will be the date of submission for purposes of determining compliance with the requirements based on the time of filing the statement, including all certification requirements for statements under 37 CFR 1.97(e). See MPEP § 609 ¶ C(1).

5. The information disclosure statement filed 29 January 2002 fails to comply with 37 CFR 1.98(a)(3) because it does not include a concise explanation of the relevance, as it is presently understood by the individual designated in 37 CFR 1.56(c) most knowledgeable about the content of the information, of each patent listed that is not in the English language. The patent DE 41 08 73 is totally in German and has not been considered.

Drawings

6. Figure 1 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g).

7. Fig. 1 is objected to as failing to comply with 37 CFR 1.84(p)(5) because it includes the following reference sign(s) not mentioned in the description: 22, 26, 28, and 30.

Art Unit: 2813

8. A proposed drawing correction, corrected drawings, or amendment to the specification to add the reference sign(s) in the description, are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Claim Objections

9. Claims 5 and 8 are objected to because of the following informalities:

In claim 5, line 3, replace "polyhyrdroxyalcohols" (emphasis added) with --polyhydroxyalcohols-- for correct spelling.

In claim 8, line 1, replace "presentafter" with --present after-- for correct spelling.

Appropriate correction is required.

Claim Rejections - 35 USC § 103

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

11. Claims 1, 3, 8-17, and 28, 30, and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent Application 2002/0027286 A1 (**Sundararajan et al.**) in view of US 6,006,763 (**Mori et al.**).

Regarding claims 1 and 28, **Sundararajan** discloses a process for producing an integrated circuit comprising forming a copper damascene structure 140, 145 on a substrate (Fig. 1A), forming a copper oxide on the copper during CMP (as further limited by instant claim 8);

Art Unit: 2813

reducing the copper oxide using “typically” hydrogen or ammonia plasma reduction (paragraphs [0008] and [0018]), prior to forming a layer comprising silicon carbide, SiC --as further limited by instant claim 30-- or comprising silicon nitride as SiCN --as further limited by instant claim 32-- more particularly SiC or SiCN (paragraph [0009] and), wherein the reduction improves the surface for depositing the SiC or SiCN layer, wherein the layer of SiC or SiCN serves as an etch stop 125 (Fig. 1B; paragraph [0022]).

Sundararajan does not teach that that reductive treatment employs contacting the copper oxide with an organic reducing agent.

Mori teaches an apparatus and method of using to provide surface treatment of integrated circuits, in general, (col. 1, lines 12-20) wherein metal oxide is reduced to metal using an organic reducing agent (paragraph bridging cols. 3-4). Exemplary organic reducing agents such as propane and decane are taught (col. 12, lines 5-34).

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use an organic reducing agent to reduce the copper oxide of **Sundararajan** to copper, as taught by **Mori**, because **Sundararajan** is not limited to any specific method and because **Mori** recognizes that metal oxides can be reduced to metals using organic material.

Regarding claim 3, an etch stop layer is a hard mask by definition. Even so, it has been held that to be entitled to weight in method claims, the recited structure limitations therein must affect the method in a manipulative sense, and not amount to the mere claiming of a use of a particular structure. See *Ex parte Pfeiffer*, 1962, C.D. 408 (1961). In this case that the SiC layer serves as a stop layer is not manipulative of the method and therefore is not considered to have patentable weight. Moreover, because the materials are the same in the same damascene

Art Unit: 2813

structure as shown in Applicant's figures, it is very clear that the SiC serves as a hardmask to every extent as indicated by Applicant.

Regarding claims 9, because the copper is necessarily exposed during CMP and cleaning, the oxide is formed by exposure to "a cleanroom atmosphere."

Regarding claims 10-12 and 14-16, **Sundararajan** discloses the deposition necessarily takes place in a first chamber. The temperature therein is 300 to 450 °C. Further regarding claim 16, although the temperature of about 400 °C is not specifically indicate, the selection of the 400 °C is obvious because it is a matter of determining optimum process condition by routine experimentation with a limited number of species. See *In re Jones*, 162 USPQ 224 (CCPA 1955)(the selection of optimum ranges within prior art general conditions is obvious) and *In re Boesch*, 205 USPQ 215 (CCPA 1980)(discovery of optimum value of result effective variable in a known process is obvious).

Regarding claim 13, that the second chamber is clustered to a first reaction chamber does not have patentable weight because it is not manipulative of the invention. See *Ex parte Pfeiffer*, as above. Nonetheless, cluster tools are known and it would be obvious to one of ordinary skill in the art to use a cluster tool with separate chambers for the separate processes as in a cluster tool, to protect the copper layer from re-oxidation prior to the deposition of the SiC layer, in accordance with the objective in **Sundararajan**.

Regarding claim 17, **Sundararajan** does not disclose the temperature at which the copper is reduced. It would have been obvious for one of ordinary skill in the art, at the time of the invention to use the same temperature for reducing the copper oxide layer as that used for deposition in order to save time in changing the temperature, and because it would appear that

Art Unit: 2813

the reduction temperature being equal to the deposition temperature would work just as well as some other temperature.

12. Claims 2 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Sundararajan** in view of **Mori** as applied to claims 1 and 28 above, and further in view of Applicant's admitted prior art (**APA**).

The prior art of **Sundararajan** in view of **Mori**, as explained above, discloses each of the claimed features except for indicating that the silicon carbide layer contains oxygen.

APA teaches that it is known to use SiC and SiOC as a barrier/etch stop layer. (See instant specification, p. 3, lines 8-10.)

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use silicon carbide with oxygen, because the selection of a known material suitable for an intended purpose is *prima facie* obvious in the absence of unexpected results. Moreover, one of ordinary skill would be motivated to use SiOC because it has a lower dielectric constant than silicon nitride, thereby aiding in the reduction of RC delay which is highly desired in the art.

13. Claims 4-7 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Sundararajan** in view of **Mori** as applied to claims 1 and 28 above, and further in view of US 5,865,365 (**Nishikawa et al.**)

The prior art of **Sundararajan** in view of **Mori**, as explained above, discloses each of the claimed features except for indicating that the organic reducing agents are specifically aldehydes, alcohols, or ketones.

Art Unit: 2813

Nishikawa teaches the method and mechanism by which aldehydes, alcohols, and carboxylic acids are reduced to metal oxides to metal, for metallization in integrated circuits (col. 6, line 47 to col. 7, line 4; col. 7, Table 1.)

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use any of the claims alcohols, aldehydes, or carboxylic acids as the organic reducing agent in **Mori** to reduce the copper oxide of **Sundararajan** because **Mori** is not limited to any specific organic reducing agent and one of ordinary skill would recognize that the reducing agents in **Nishikawa** would work just as well for reducing metal oxide to metal as those in **Mori**. Moreover it has been held that the selection of a material suitable for an intended purpose is *prima facie* obvious in the absence of unexpected results. There exists no evidence of record that the organic reducing agents presently claimed perform any better than those in **Mori** or **Sundararajan**.

Conclusion

14. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

US 6,444,564 B1 (**Sundararajan et al.**) is a patent based on a divisional application of the parent **Sundararajan** application applied above.

US 6,433,432 B2 (**Shimizu**) teaches reduction of copper oxide to copper metal before forming silicon nitride or carbide layer thereover. (See col. 4, lines 41-48; paragraph bridging cols. 4-5; and col. 7, last paragraph.)

Art Unit: 2813

US Patent Application (Ohto) discloses adhesion of SiN layers is better after reducing the copper oxide to metal. (See paragraphs [0008]-[0009].)

15. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erik Kielin whose telephone number is 703-306-5980. The examiner can normally be reached on 9:00 - 19:30 on Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached at 703-308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.



Erik Kielin
October 11, 2002